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DRIVE FOR AN ADJUSTER DEVICE IN A MOTOR VEHICLE

15 **Description**

The invention relates to a drive for an adjuster device in a motor vehicle according to the preamble of patent claim 1.

20 A drive of this kind comprises a drive motor, a drive element mounted rotatable about a drive axis, e.g. in the form of a rotor of the drive motor; as well as a device for the self-locking of the drive element which in the de-energised state of the drive motor locks the drive element with a locking element.

25 From DE 199 42 362 C1 a self-locking electric drive is known having an electric motor and a transmission on the output side with a transmission housing, a gear output shaft rotatable relative to the transmission housing, and a drive for the self-locking of the gear output shaft, and which has a locking element which at the same time as the electric motor is operated is displaceable electrically from a first position

30 to a second position, as well as an element which is fixed relative to the transmission housing wherein the locking element in the first position produces a positive coupling between the gear output shaft and the fixed element and wherein this coupling is disengaged in the second position. The fixed element is thereby formed by a gear axis on which the locking element is mounted displaceable in the axial direction.

35 With this arrangement a self locking electric drive can be produced in which a sufficiently strong self-locking action is ensured, thus it is prevented that with the electric motor switched off torque applied on the output side can be transferred to the

drive side, without the efficiency of the drive hereby being adversely affected by too much. However the known arrangement has the drawback that owing to the ability of the locking element to move in the axial direction in order to produce and clear the self locking action it requires a certain extension in the axial direction. This goes
5 against the desire, particularly in the case of flat motors, of obtaining the smallest possible extension of a motor in the axial direction which for reasons of space is of great importance in electric drives for motor vehicles .

10 The object of the invention is therefore to provide a drive of the type mentioned at the beginning which is characterised by a compact structure.

This is achieved according to the invention by providing a drive with the features of patent claim 1.

15 According to this the locking element for operating the drive motor can be brought out of engagement with the drive element in the radial direction relative to the drive axis in order to permit movement of the drive element during energising of the associated drive motor.

20 Bringing the locking element out of engagement can on the one hand take place when energising the drive motor, e.g. by using the electric current which is used to energise the drive motor at the same time to actuate the locking element, possibly by means of an electromagnet. On the other hand it can also be provided that the locking of the drive element is cleared prior to energising the motor so that at the
25 start of operating the motor the locking element is in each case out of engagement with the drive element. This type of timed control of lifting the locking element from the drive element can be particularly advantageous if the locking element is in positive engagement with the drive element.

30 Conversely the locking element on switching off the drive can be moved radially into engagement again with the drive element so that a rotational movement of the drive element about its drive axis is locked and the transfer of forces applied on the output side to the drive side is prevented (self-locking). This engagement process can be controlled so that there is no sudden engagement but a controlled measured
35 engagement, e.g. to prevent noises.

The solution according to the invention has the advantage that it enables a self locking action which on the one hand does not impair the efficiency of the drive and which on the other hand requires no special extension of the drive motor in the axial direction.

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The solution according to the invention is therefore particularly suitable for use in the case of flat motors which have for example a rotor in the form of a disc rotor wherein the locking element during energising of the flat motor is lifted in the radial direction from the drive element so that the forces generated by the flat motor lead to a rotational movement of the drive element. When using the solution according to the invention for a flat motor having a disc rotor (disc rotor motor) in which the locking element can be brought in and out of engagement radially with the rotor (armature disc), it enables the large friction radius of the armature disc to guarantee a sufficient self locking action with comparatively small braking forces. The permanent magnetic energy which is constantly available locks the armature disc when the motor is not energised, that is on applying a force on the output side, e.g. on a window pane which is to be adjusted through the drive or on a seat part which is to be adjusted through the drive. The self locking action is hereby not generated in the first instance through the gear configuration but is obtained through a permanent magnetic brake which manages without any additional energy source.

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In order to bring the locking element out of engagement with the drive element when the drive motor is energised, according to a variation of the invention an elastic element can be used which is coupled to the drive motor in the suitable way so that during energising of the drive motor the locking of the drive element can be lifted.

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In a particularly preferred variation of the invention the locking element can be brought electrically out of engagement with the drive element.

In the de-energised state of the drive motor the locking element can be fixed in a position locking the drive element through magnetic forces. The magnetic forces can be generated for example through a permanent magnet which forms the stator of the drive motor. Thus a permanent magnet which is in any case provided as a stator in the motor can hereby be used to generate the brake force with which the drive

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element is locked when the (de-energised) drive motor is switched off.

The locking element has itself a first magnetisable section whose magnetisation fixes the locking element in a position in which it locks the drive element. The said first
5 magnetic section defines a first magnetic path for the magnetic flux which is generated by the magnet used to fix the locking element and with which a magnetic force is produced which fixes the locking element in its position locking the drive element.

10 In order to bring the locking element out of engagement with the drive element when the drive motor is energised it is possible to use an electromagnet which is for example energised together with the drive motor and which generates a magnetic field through whose flux or force action the locking element is brought out of
15 engagement with the drive element. Through a suitable timed control of the energising of the electromagnetic or the lifting of the current through the electromagnet it is thereby possible to control the timed connection between the start of operation of the drive motor and the release of the locking element, as well as to obtain a smooth re-engagement of the locking element in the drive element when the
20 drive motor is switched off.

20 According to one embodiment of the invention the field produced by the electromagnet deflects the magnetic flux serving to fix the locking element when the drive motor is de-energized so that the resulting magnetic flux brings the locking element out of engagement with the drive element. With the deflection of the
25 magnetic field the (permanent magnetic) flux which fixes the locking element when the drive motor is de-energised is, after the motor and electromagnet are energised, no longer guided over the short circuit acting as the friction brake but a side path is offered for the flux in which this causes no fixing of the locking element in a position
30 in which it engages with the drive element. The friction brake is thereby released and the drive element can rotate freely. When the motor is switched off the (permanent magnetic) flux is again guided through the short-circuit acting as the brake and thus re-establishes the self locking action.

According to another embodiment of the invention the (permanent magnetic) flux fixing the locking element when the drive motor is de-energised is displaced through the magnetic field which is produced by means of an electromagnet when the motor is energised so that the resulting magnetic flux brings the locking element out of engagement with the drive element. During the displacement of the magnetic field the (permanent magnetic) flux is thus displaced by a counter excitation which is produced by energising an electromagnet. Energising the electromagnet takes place at the same time as the motor is switched on and leads to a displacement of the (permanent magnetic) flux into a side path provided for this. When the motor is switched off again the counter excitation is automatically deactivated and the locking element is fixed again by the magnetic flux in a position in which it locks the drive element.

According to a further variation of the invention a permanent magnet through which the locking element can be fixed in a position locking the drive element, as well as an electromagnet or the magnetic fields produced by these two magnets, are integrated into one hybrid magnetic circuit so that the permanent magnetic flux superimposes the electromagnetic flux and the locking element can hereby occupy two stable positions (end positions) of which one engenders the locking of the drive element and the other enables a rotational movement of the drive element. In both stable positions (end positions) the electromagnet can hereby be de-energised each time whereby the transition from one stable position to the other is triggered through a temporary energising of the electromagnet with a current impulse. As a result with the embodiment of the invention described above a permanent magnet which is provided in any case in the drive and serves to produce the stator field can be directed into a hybrid magnetic circuit so that its flux is superimposed on the electromagnetic flux produced by an electromagnet and the release and closing of the brake is brought about each time through a short current impulse when switching the motor on and off whereby the two end positions of the locking element corresponding with the associated stable positions of the brake are each time occupied de-energised.

A magnetic brake unit of this kind is owing to the permanent magnetic pre-magnetisation characterised through small electrical and mechanical time constants, that is the current and the brake force rise up rapidly. The brake force can be introduced in a controlled measured manner by suitably adjusting the current which is used to energise the electromagnet. In particular the brake unit can be intelligently

controlled through the motor electronics, e.g. if a vertically movable window starts to become jammed the motor brakes faster than when the window pane moves orderly into an end position. The hybrids to be used for producing a hybrid magnetic circuit furthermore have the advantage that they are small and light.

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In a further development of the invention the locking element has a brake element which in order to lock the drive element acts on same, namely preferably as a (elastically designed) friction element. The locking element or its brake element is for this guided movable in the radial direction on a guide device, namely is more particularly radially displaceable. It is however possible to provide a positive engagement of the locking element in the drive element instead of a force locking or friction locking engagement.

Furthermore in order to intensify the brake force (in the case of a force locking brake action) or to deliberately adjust (e.g. lengthen) the path required for the locking element to move in and out (particularly in the case of a positive locking brake action) the locking element can be actuated through a lever mechanism.

Further features and advantages of the invention will now be apparent from the following description of an embodiment with reference to the drawings.

They show:

Figure 1 a diagrammatic view of a drive motor for an adjuster device in a motor vehicle, with a device for locking the rotor in the de-energised state;

Figure 2 a drive motor according to Figure 1 at the start of energising the motor;

Figure 3 a drive motor according to Figure 1 during operation of the motor.

Figure 1 shows of a drive motor designed as a flat motor for an adjuster device in motor vehicles, e.g. for adjusting a window pane, (electric window lifter) or for adjusting a seat part (electric seat adjuster) a disc rotor 1 (armature disc) as well as

a stator 2 which is formed by permanent magnets 21, 22. The disc rotor 1 is mounted to rotate about an axis A on a shaft (not shown in Figure 1).

The drive motor illustrated in Figure 1 is characterised as a result of the design of the rotor 1 as a disc rotor or armature disc in particular through its small extension along the drive axis A of the disc rotor 1. This plays a significant part in adjuster devices in motor vehicles, e.g. in the form of an electric window lifter or electric seat adjuster since often there is only little space available for the drive motor.

In order to prevent that when the drive is switched off, i.e. is de-energised a force applied on the output side, e.g. on a window pane to be adjusted or on a seat part to be adjusted can be transferred to the drive side, the drive motor is allocated a brake device 3, 4, 5 which comprises a locking element 3, a guide device 4 for guiding the locking element 3 in the radial direction R relative to the drive axis A as well as an electromagnet 5 for actuating the locking element 3.

The locking element 3 comprises an elastically deformable brake element 30 in the form of a friction brake which can be brought into engagement with the outer edges of the disc rotor 1 and hereby locks this so that it cannot execute any rotational movement about the drive axis A. The brake element 30 is connected to a body of magnetic material which comprises a first magnetisable section 31 as well as a second magnetisable section 32 which can each form a path for the magnetic flux which is generated by the stator 2 or electromagnet 5. Furthermore the locking element 3 comprises guide regions 35 which are guided together with the two current paths 31, 32 displaceable in a radial direction R on a guide element 4 consisting of two elongated guide parts 41, 42. A magnetic plate 40 is mounted on the guide device 4 on the side remote from the disc rotor 1 and stator 2.

The electromagnet 5 is connected to the locking element 3 so that it can be displaced together with same in the radial direction R relative to the drive axis A.

Figure 1 shows the electric drive motor 1, 2 when it is switched off, i.e. in the de-energised state. In this case the electromagnet 5 is also de-energised. The

magnetic flux F is therefore solely generated by the permanent magnets 21, 22 of the stator 2. The magnetic flux F extends through the shortest available path, namely the first path 31 of the locking element 3. A magnetic force is hereby generated which moves the brake element 30 in the direction of the drive motor 1, 2 so that the elastically deformable brake element 30 presses against the outer edge of the disc rotor 1 and locks this through friction action. The disc rotor 1 can hereby not turn about its drive axis A and the transfer of torque applied on the output side to the drive side is ruled out. This corresponds to a self locking action of the drive motor 1, 2 in the de-energised state. The operating air gap L between the outer edge of the drive motor 1, 2 and the locking element 3 is hereby minimised.

Figure 2 shows the drive motor 1, 2 of Figure 1 when the drive motor is switched on, i.e. at the start of energising of the drive motor 1, 2 whereby at the same time the electromagnet 5 is energised. The current direction of the current flowing through the electromagnet 5 is thereby selected so that the magnetic flux generated by the electromagnet 5 runs oppositely to the magnetic flux generated by the permanent magnet 21, 22 and thus displaces same (magnetic field displacement). In the region of the operating air gap L between the outer edge of the drive motor 1, 2 and the locking element 3, the permanent magnet 21, 22 on the one side and the first magnetic section 31 of the locking element 3 facing the outer edge of the drive motor 1, 2 on the other are oppositely magnetised so that the brake element 3 is repelled in the radial direction R and the operating air gap L is enlarged. The brake which ensures the self-locking action in the de-energised state of the drive motor 1, 2 is thereby released.

In the situation shown in Figure 3 the brake is completely opened. The resulting magnetic flux F generated by the permanent magnet 21, 22 and the electromagnet 5 now extends through a side path which is formed by the second magnetic section 32 of the locking element 3 and by the plate-shaped section 40 of the guide device 4. The locking element 3 is hereby fixed in a radial position in which the brake element 30 is located out of engagement with the disc rotor 1 so that this can rotate freely about the drive axis A and a torque applied on the drive side can be transferred to the output side.

Very similar conditions to those described above regarding the magnetic field displacement exist with the so-called magnetic field deflection. Here a switch (magnetic switch) is electrically actuated and the magnetic field is hereby deflected through a second flux path.

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Furthermore the arrangement according to Figures 1 to 3 also meets the requirements for a construction with hybrid magnets with two stable end positions which can be occupied in the de-energised state. The activation and deactivation of the brake takes place for example through a short current impulse according to the

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The brake device 3, 4, 5 illustrated in Figures 1 to 3 for a disc rotor motor 1, 2 has the advantage that on the one hand it causes in the de-energised state a reliable self-locking of the drive without influencing the efficiency in the operation of the motor and that on the other hand it does not influence the extension of the flat motor 1, 2 in the axial direction, thus along the drive axis A.

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The force with which the brake element 30 when the drive motor is switched off is held in its position which locks the drive element (disc rotor 1), can as an alternative to the embodiment in Figures 1 to 3 also be applied mechanically e.g. through a pretensioned spring. When the drive motor is energised the pretensioning force of the spring can then be lifted e.g. through the oppositely acting force of an electromagnet. A magnetic element e.g. a ferro-magnet can thereby be provided on the brake element (e.g. on a positive locking element having teeth) as a reaction

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element on which the forces of the electromagnet act.